11
7
2
clamping force

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TITLE: ROTOR FOR STEPPING MOTOR AND MANUFACTURE THEREOF

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ABSTRACT:

PURPOSE: To prevent an edge of end faces of a permanent magnet from being chipped, cracked or damaged due to contact with a foreign matter by extending resin to the edge of both end faces of the permanent magnet so that it may be formed in the shaped of a flange, in a rotor which is made by connecting and fastening the cylindrical permanent magnet and a shaft with resin.

CONSTITUTION: A shaft 3 is longitudinally located at the center of a cylindrical space of a molding die and then, a permanent magnet 1, a spacer 2 and another permanent magnet 1 are stacked in order. Projections which, being

brought into contact with a part of a lower end face of the permanent magnets,
support the permanent magnets are provided at the bottom of the molding die to
position the permanent magnets 1. When the molding die is filled with resin by
injection, the resin creeps through a space between the projections and then
goes around to an edge of the permanent magnets, forming flanges 11. By this
method, the edge of end faces of the permanent magnets 1 are covered with the
resin 7 and therefore, a part of the permanent magnets which are easily brought
into contact with the other components is protected at the time of assembly and
chipping or cracking of the permanent magnets can be avoided.

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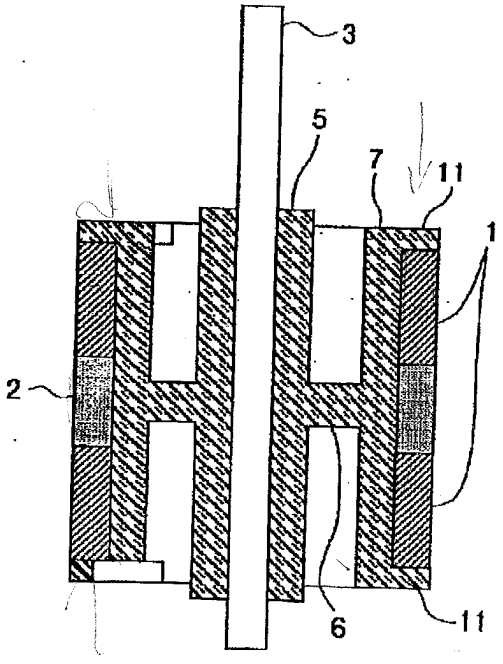
(54)【発明の名称】　ステッピングモータ用ロータおよびその製造方法

(57)【要約】

【目的】　永久磁石形ステッピングモータ用ロータにおいて、内周が樹脂７で固定された円筒状の永久磁石１の両端面の外周縁部に欠けや割れが発生するのを防止する。

【構成】　円筒状の永久磁石１の両端面の外周縁部まで樹脂７を延設するために、成形金型の底部に一体的に設けられた突起、成形金型の底部内周面から出没可能な支持材、あるいは前記樹脂に一体固着されてしまうスペーサなどを配置する。または、それらを配置せずに、成形金型へ永久磁石を圧入して、永久磁石を永久磁石の外周面と成形金型の内周面との間の面圧力によって保持し、永久磁石の下端面と成形金型の底部との間に隙間を設けて樹脂を回り込ませる。



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【特許請求の範囲】

【請求項１】　円筒状の永久磁石と該永久磁石の中心に配置された軸とを樹脂により連結固定させたステッピングモータ用ロータにおいて、前記樹脂が前記円筒形の永久磁石の両端面の外周縁部まで鍔状に延設されていることを特徴とするステッピングモータ用ロータ。

【請求項２】　成形金型内に円筒状の永久磁石を配置し、該永久磁石の中心に軸を縦に配置して、前記成形金型内に樹脂を充填して両者を連結固定するステッピングモータ用ロータの製造方法において、前記成形金型の底部に突起を形成して前記円筒状の永久磁石の下端面を支持させることで、前記樹脂が前記永久磁石の上端面のみならず下端面の外周縁部までも回り込んで鍔状に延設されることを特徴とするステッピングモータ用ロータの製造方法。

【請求項３】　成形金型内に円筒状の永久磁石を配置し、該永久磁石の中心に軸を縦に配置して、前記成形金型内に樹脂を充填して両者を連結固定するステッピングモータ用ロータの製造方法において、前記成形金型の底部に前記円筒状の永久磁石の下端面を支持する支持材を設け、該支持材は前記成形金型の内面に形成された孔部から出没可能に設けられるとともに、前記樹脂が充填され成形がなされた際に前記孔部に没入させることを特徴とするステッピングモータ用ロータの製造方法。

【請求項４】　前記出没可能な支持材は、前記成形金型の内方へこれを付勢するバネを介して設けられ、該成形金型内に充填される樹脂の圧力で前記孔部に没入されるとともに、前記成形金型内からロータ成形品が取り出されたときに前記バネの復元力により元の位置に復帰することを特徴とする請求項３に記載のステッピングモータ用ロータの製造方法。

【請求項５】　円筒状の永久磁石と該永久磁石の中心に配置された軸とを樹脂により連結固定させたステッピングモータ用ロータにおいて、前記円筒状の永久磁石の端面に前記樹脂と一体的に固着されるスペーサを設け、前記樹脂が該スペーサまたはスペーサの間隙を通って前記端面の外周縁部まで鍔状に延設されていることを特徴とするステッピングモータ用ロータ。

【請求項６】　成形金型内に円筒状の永久磁石を配置し、該永久磁石の中心に軸を縦に配置して、前記成形金型内に樹脂を充填して両者を連結固定するステッピングモータ用ロータの製造方法において、前記成形金型の底部に前記円筒状の永久磁石の下端面を支持するスペーサを配置し、成形の際に前記樹脂と該スペーサとを一体的に固着させ、前記スペーサまたはスペーサの間隙を通って前記下端面の外周縁部まで前記樹脂を延設することを特徴とするステッピングモータ用ロータの製造方法。

【請求項７】　成形金型内に円筒状の永久磁石を配置し、該永久磁石の中心に軸を縦に配置して、前記成形金型内に樹脂を充填して両者を連結固定するステッピング

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モータ用ロータの製造方法において、前記成形金型の内径を前記永久磁石の外径よりも小さく設定し該永久磁石を該成形金型に圧入することで前記永久磁石をその外周と前記成形金型の内壁面との面圧力により支持し、該永久磁石の下端面と前記成形金型の底部との間に隙間を設け、前記樹脂が前記隙間から前記永久磁石の下端面の外周縁部まで回り込んで鍔状に延設されることを特徴とするステッピングモータ用ロータの製造方法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、例えば永久磁石形ステッピングモータに用いられる樹脂ロータとそのロータの製造方法とに関する。

【０００２】

【従来の技術】例えば永久磁石形ステッピングモータは、回転自在に支持された樹脂ロータに対向するように、磁極歯を有するステータヨークを配置したものである。この樹脂ロータは、例えば図１０，図１１に示すように、中空の円筒状に形成された永久磁石１と、永久磁石１の中心に位置する軸３と、この軸３が嵌入するボス部５および前記永久磁石１の内周を一体に固着成形するモールド樹脂７とから構成されている。

【０００３】このような樹脂ロータの製造は、図１２に示すように、成形金型９の内部に円柱状の空間を形成し、その中に円筒状の永久磁石１、および永久磁石１の中心に縦方向に配置された軸３を配し、樹脂を例えば射出充填して両者１，３を連結固定して行うものであった。

【０００４】このようにして製造された樹脂ロータの永久磁石１の端面は、その肉厚の半分程の寸法Ｌの部分が露出していた（図１０）。すなわち、永久磁石の肉厚の半分程度の寸法だけ半径方向に延設された樹脂の鍔１１により、永久磁石１の端面は半径方向の内側が半分ほど覆われていた。このように半分が露出し半分が樹脂によって覆われるのは、永久磁石１を成形金型９の中に縦に配する際に、位置決めのために永久磁石１の下端を成形金型９の底部に接触させる必要があるからである。

【０００５】

【発明が解決しようとする課題】このようにして露出した永久磁石１の端面の外周縁部が、ステッピングモータ組立の際にステータヨークなどに接触すると、欠けや割れが発生し、また樹脂ロータを誤って落下させた場合などには前記縁部が完全に破損する場合もあった。このような欠け、割れ、あるいは破損が発生すると、その樹脂ロータは不良品となってしまう。

【０００６】本発明は、以上の問題点を解決するために成されたもので、端面の外周縁部に欠け、割れ、あるいは破損が生じることを防止できるステッピングモータ用ロータおよびその製造方法を提供することを目的とする。

【0007】

【課題を解決するための手段】以上の目的を達成するために、この出願の第1発明は、円筒状の永久磁石と該永久磁石の中心に配置された軸とを樹脂により連結固定させたステッピングモータ用ロータにおいて、前記樹脂が前記円筒形の永久磁石の両端面の外周縁部まで鍔状に延設されていることを特徴とするステッピングモータ用ロータである。

【0008】第2発明は、成形金型内に円筒状の永久磁石を配置し、該永久磁石の中心に軸を縦に配置して、前記成形金型内に樹脂を充填して両者を連結固定するステッピングモータ用ロータの製造方法において、前記成形金型の底部に突起を形成して前記円筒状の永久磁石の下端面を支持させることで、前記樹脂が前記永久磁石の上端面のみならず下端面の外周縁部までも回り込んで鍔状に延設されることを特徴とするステッピングモータ用ロータの製造方法である。

【0009】第3発明は、成形金型内に円筒状の永久磁石を配置し、該永久磁石の中心に軸を縦に配置して、前記成形金型内に樹脂を充填して両者を連結固定するステッピングモータ用ロータの製造方法において、前記成形金型の底部に前記円筒状の永久磁石の下端面を支持する支持材を設け、該支持材は前記成形金型の内面に形成された孔部から出没可能に設けられるとともに、前記樹脂が充填され成形がなされた際に前記孔部に没入させることを特徴とするステッピングモータ用ロータの製造方法である。

【0010】この出没可能な支持材は、第4発明のように、バネを介して設けられ、充填される樹脂の圧力で孔部に没入させるとともに、前記成形金型内からロータ成形品が取り出されたときに前記バネの復元力により元の位置に復帰させることができる。

【0011】第5発明は、円筒状の永久磁石と該永久磁石の中心に配置された軸とを樹脂により連結固定させたステッピングモータ用ロータにおいて、前記円筒状の永久磁石の端面に前記樹脂と一体的に固着されるスペーサを設け、前記樹脂が該スペーサまたはスペーサの間隙を通って前記端面の外周縁部まで鍔状に延設されていることを特徴とするステッピングモータ用ロータである。

【0012】第6発明は、成形金型内に円筒状の永久磁石を配置し、該永久磁石の中心に軸を縦に配置して、前記成形金型内に樹脂を充填して両者を連結固定するステッピングモータ用ロータの製造方法において、前記成形金型の底部に前記円筒状の永久磁石の下端面を支持するスペーサを配置し、成形の際に前記樹脂と該スペーサとを一体的に固着させ、前記スペーサまたはスペーサの間隙を通って前記下端面の外周縁部まで前記樹脂を延設することを特徴とするステッピングモータ用ロータの製造方法である。

【0013】第7発明は、成形金型内に円筒状の永久磁

石を配置し、該永久磁石の中心に軸を縦に配置して、前記成形金型内に樹脂を充填して両者を連結固定するステッピングモータ用ロータの製造方法において、前記成形金型の内径を前記永久磁石の外径よりも小さく設定し該永久磁石を該成形金型に圧入することで前記永久磁石をその外周と前記成形金型の内壁面との面圧力により支持し、該永久磁石の下端面と前記成形金型の底部との間に隙間を設け、前記樹脂が前記隙間から前記永久磁石の下端面の外周縁部まで回り込んで鍔状に延設されることを特徴とするステッピングモータ用ロータの製造方法である。

【0014】

【作用】鍔状に延設された樹脂により、円筒状の永久磁石の両端面の外周縁部まで覆われるので、この縁部にステータヨークなどが接触し欠けや割れさらには破損を生じる可能性を小さくできる。

【0015】このように樹脂を鍔状に延設するには、成形金型の底部に突起を形成して、永久磁石の下端面と底部との間に隙間を設けることにより樹脂を回り込ませて行うことができる。

【0016】あるいは、成形金型の内面に形成された孔部から出没可能に設けられる支持材で永久磁石の下端面を支持し、この下端面と成形金型の底部との間に隙間を設けることによっても行われる。この支持材はバネを介して設け、充填される樹脂の圧力を利用して成形金型の内部に没入させるとともに、前記成形金型内からロータ成形品が取り出されたときに前記バネの復元力により元の位置に復帰させることができる。

【0017】また、前記支持材の代わりに、円筒状永久磁石の下端面をスペーサで支持し、スペーサの間隙を通って樹脂が鍔状に延設されるようにすることができ、この場合にはスペーサは製造されたロータの永久磁石の端面に一体的に固着されて残る。

【0018】また、永久磁石を成形金型へ圧入し、圧入の面圧力によって永久磁石を支持するものとすれば、前記支持材、あるいはスペーサを用いることなく円筒状永久磁石の端面外周縁部まで樹脂を鍔状に延設することができる。

【0019】

【実施例】第1および第2発明に関する実施例を図1～図4を基に説明する。図1および図2に示すロータは、円筒状の2個の永久磁石1を、軸3の長手方向に並設したものである。これら永久磁石1と軸3とは、樹脂7によって連結固定されている。すなわち、軸3は樹脂により形成されたボス部5に嵌入された状態となっており、ボス部5に連続するリブ6が、永久磁石1内周の樹脂7に一体的に連続している。

【0020】この樹脂7は、円筒状の永久磁石1の両端面の外周縁部まで達する鍔11を形成している。すなわち、下端面においては、図2に示すようにロータの円周

方向に１２０°ピッチで放射状部分１３が形成されている。各放射状部分１３の先端は、外周縁部まで達している。そして、先端は円周方向に伸び、細いリング状部分１５を形成している。このリング状部分１５の半径方向の寸法は、永久磁石１の円筒の肉厚寸法の約１／２程度である。放射状部分１３同士の間は、略扇状の凹部１７となっており、樹脂７で覆われていない。

【００２１】なお、本実施例にあっては、永久磁石１の上端面側の鍔１１には前記のような凹部１７が形成されておらず、永久磁石１が露出する部分はないが、永久磁石１の上端面側の鍔１１にも下端面側と同じ凹部１７を形成してもよい。

【００２２】図１および図２に示すロータは、成形金型の底部に略扇状の突起（図示せず）を形成することで製造される。すなわち、従来と同様に成形金型の円柱状の空間の中に、前記円筒状の永久磁石１、および円筒状の中心に位置する軸３を縦に配置する。２つの永久磁石１同士の間にはスペーサ２が設けられ、永久磁石１，スペーサ２，永久磁石１が順に軸３の長手方向に積み重ねられた状態となって配置される。この成形金型の底部には、３つの略扇状の突起が、各々１２０°の間隔で形成されている。略扇状の突起の半径方向外側の端部は、永久磁石１の下端面肉厚の約１／２程度まで接触し支持している。この接触により、永久磁石１の位置決めが行われる。

【００２３】永久磁石１および軸３を配置した後、樹脂を射出充填すると、樹脂は突起同士の間隙を通って回り込み永久磁石１の外周縁部まで達する。これにより鍔１１の放射状部分１３およびリング状部分１５が形成される。なお、永久磁石１の上端面では、位置決めのための突起を設ける必要がないので、前記のような凹部１７はできず、上端面全体が樹脂７の鍔１１で覆われる。

【００２４】以上説明したように、図１および図２の実施例によれば、永久磁石１の下端面は、凹部１７が形成され永久磁石１の端面が露出する部分は残るものの、外周縁部は樹脂７によって覆われるので、他の部品、例えばステッピングモータの組立の際に隣り合うステータヨークなどに接触し易い部分を保護でき、欠けや割れの発生を抑止できる。またロータを誤って落下してしまった場合にも破損する可能性を減少させることができる。

【００２５】以上の実施例では永久磁石１の下端面を支持する突起は略扇状をしており、したがって凹部１７も略扇状となるものであったが、図3および図４に示す他の実施例のように突起を小さな円柱状又は半球状とし、凹部１７を小さくし永久磁石１の端面の露出面積を小さくすることができる。

【００２６】なお、以上の実施例において突起の数は3個であった（図2および図４）が、図示しない他の実施例においては４個以上であっても構わない。

【００２７】さらに、永久磁石１の数は２個であった

が、図示しない他の実施例においては１個、あるいは３個以上であっても構わない。

【００２８】次に、第３発明および第４発明に関する実施例を図５を基に説明する。すなわち、前記実施例では成形金型９の底部に突起を設けたが、本実施例は成形金型９の底部内周に出没可能な支持材１９を備えている。本実施例にあっては、この支持材１９は横置きされた円筒状の可動ピンであり、成形金型９の底部付近の側壁に形成された円筒状の孔部２１内に、バネ２３を介して設けられたものである。この支持材１９は例えば４本設けられ、成形金型９の底部内周の円周方向に等間隔に設けられている。バネ２３としては、射出充填された樹脂の圧力により充分に圧縮されて孔部２１の内方に没入可能となるバネ定数を有するものを選定する。なお、イジェクトピン２５は、４本設けられた支持材１９と干渉しない位置に設けられる。

【００２９】樹脂が射出されると、永久磁石１と軸３との間の空間は、樹脂により徐々に充填されて行く。やがて樹脂は成形金型９の底部に達し、支持材１９にも樹脂の充填圧力が及ぶ。この圧力により、支持材１９はバネ２３の復元力に抗して後退し、孔部２１内に没入する。この没入の時期までには、永久磁石１は充填された樹脂によって支持されるようになっており、永久磁石１の下端面と成形金型９との間には隙間が維持される。この隙間に樹脂が回り込み、永久磁石１の下端面の全体に鍔状に延設される。

【００３０】なお、図５の実施例においては支持材１９は射出充填される樹脂の圧力を利用して孔部２１へ没入させるものであったが、図示しない他の実施例においては、電気的または機械的な手段で支持材１９を移動させるように構成して、孔部２１から出没可能にすることができる。このようにすると、樹脂の射出・保圧タイミングと電気的または機械的な手段の動作タイミングとを調整して支持材１９の出没を行うことができる。

【００３１】次に、第５および第６発明に関する実施例を図６～図８を基に説明する。すなわち、以上の実施例（図１～図５）にあっては、成形金型９の底部に突起や支持材を設けるようにしていたが、本実施例にあっては成形金型９の底部にスペーサ２７を配置し、このスペーサ２７は樹脂射出成形後にはロータに一体的に固着されてそのロータの一部となる。

【００３２】このスペーサ２７は、例えば図７のように、円筒状永久磁石１の下端面を完全に覆って保護する保護フランジ部２９と、永久磁石１の内周側に挿入される短円筒状の挿入部３１、挿入部３１の端部から内方側へ突出し樹脂の内部に係合する係合部３３とから成る。

【００３３】このスペーサ２７を成形金型９の底部に配置し、その上に永久磁石１の下端面を載せて位置決めする。スペーサ２７と永久磁石１とは、その後に充填される樹脂により連結固定される。本実施例では特に、スペ

ーサ２７の係合部３３が樹脂に食い込むように係合し、スペーサ２７と樹脂７とが一体固着するのを助ける。

【００３４】なお、永久磁石１の上端面は、下端面のような位置決めのための接触が必要でないのでスペーサ２７を設ける必要がない。

【００３５】図６および図７の実施例は、スペーサ２７が永久磁石１の下端面の全体を覆って保護するものであったが、図８に示すように、単に永久磁石１の下端面と成形金型９の底部との間に所定の隙間を設けるためだけのものとすることができる。

【００３６】すなわち、図８のスペーサ２７は細いリング状をしており、円筒状永久磁石１の軸方向に凹凸を繰り返すジグザグ形状となっている。この凹凸部の段差が有する軸方向の高さＨにより、前記永久磁石１と成形金型９の底部との隙間が確保される。このスペーサ２７も樹脂７の中に埋め込まれ一体固着される。成形の際に樹脂は、このスペーサのジグザグ形状の間隙を通って半径方向外方側へ鍔状に延設される。この鍔状に延設された部分は成形金型９の内周側壁にまで達し、永久磁石１の下端面の外周縁部まで覆うことになる。

【００３７】なお、このようなスペーサ２７の形状は図７および図８に示したものに限るものではなく、他の種々の形状のものが考えられる。要するに、スペーサ２７によって永久磁石１の下端面の全体を覆うものは、樹脂との一体固着性を確保できる材質あるいは形状を有していればよい。またスペーサ２７を通って延設される鍔状の樹脂部分により下端面が覆われるものは、樹脂が充分に永久磁石１の下端へ回り込んで延設され得るように、永久磁石１の下端面と成形金型９の底面との間に所定の高さの隙間を確保できるものであればよい。

【００３８】次に、第７発明の一実施例を図９を基に説明する。これまでの実施例は、突起、支持材１９、あるいはスペーサ２７などの成形金型９に対する付属物、あるいは成形金型９とは別体の手段によって永久磁石１の下端面を支持するものであったが、本実施例は前記のような付属物および別個の手段を用いることなく、永久磁石１を成形金型９へ圧入し、その際の両者間の面圧力により永久磁石１を支持するものである。

【００３９】すなわち、例えば、円筒状永久磁石１の外形が１８㎜程度、肉厚が１㎜程度である場合に、成形金型９の円柱状の空間の内径が前記永久磁石１の外径に対して１０μｍ程度の締め代（一般的にこの締め代の値は、５０μｍ程度まで許容される）を有するように形成しておき、永久磁石１を成形金型９に圧入するようにすると、永久磁石１の外周面は成形金型９の内壁に強く接触する。このときの永久磁石１外周面と成形金型９内周面との面圧力により、所定の深さまで圧入された永久磁石１を支持する。永久磁石１同士の間にはスペーサ２を挿入する。これにより、永久磁石１の下端面と成形金型９の底部との間に所定の隙間３５を設けることができ、この隙間３５から射出充填された樹脂が永久磁石１の下端面へ回り込み、鍔状に延設される。

【００４０】本実施例では、このように、永久磁石１及びスペーサ２を成形金型９内に圧入するのみで永久磁石１の位置決めができるので、永久磁石１の下端面を別個の手段で保持することなく、永久磁石１下端面の全体に樹脂を回り込ませ鍔状に延設させて覆うことができる。

【００４１】なお、前記本願第７発明に係る実施例にあっても、永久磁石を２個ではなく１個あるいは３個以上とすることができる。

【００４２】さらに、図１、図３、および図６に示したロータの断面図には、軽量化のために形成された空洞部分（ボス部５の周囲）が示されている。これらの空洞部分は、図５あるいは図９中に示されている成形金型９の上に取り付けられる雄金型などに設けられた凸部により形成されるものであるが、図を簡略化するために凸部は省略して図示するものとする。

【００４３】

【発明の効果】以上説明したように、本発明によれば、永久磁石と軸を連結固定する樹脂を、永久磁石の円筒状の両端面の外周縁部まで延設したので、ステッピングモータの組立などの際に外周縁部がステータヨークなどに接触して欠けや割れが発生したり、誤ってロータを落下させてしまった場合に破損したりする可能性を抑えることができる。

【００４４】また、前記のように樹脂を鍔状に外周縁部まで延設するために、成形金型の底部に突起を形成することは、欠け，割れ、あるいは破損の生じにくいステッピングモータ用ロータを製造するための実用的な製造方法を提供できる。

【００４５】また、前記突起の代わりに、成形金型の底部内周面に出没可能な支持材を設けることで、前記突起に当接する永久磁石の部分が樹脂で覆われずに露出されて残ることを防止できる。

【００４６】特に、前記支持材を成形金型の内方へ付勢するバネを介して設け、射出成形時に樹脂の充填圧力で前記バネの付勢力に抗して成形金型の内周面に没入するようにすれば、樹脂を充填するだけで支持材を移動でき、しかも成形品取り出し後は支持材が直ちに元の位置に復帰するので、作業が簡略化される。

【００４７】また、端面用のスペーサまたはスペーサの間隙を通って延設される樹脂の鍔状の部分によって永久磁石下端面の外周縁部まで覆うようにすれば、前記没入可能な支持材を設けるよりもさらに簡単な手段で、永久磁石の端面に露出部分が残ることを防止できる。

【００４８】さらに、成形金型へ永久磁石を圧入することにより、永久磁石の底面を成形金型の底部から所定間隔だけ浮かせるための前記突起，支持材、あるいはスペーサなどを用いることなく、永久磁石の下端面に樹脂で覆われていない露出部分を残さずに済む等、種々の優れ

た効果を奏する。

【図面の簡単な説明】

【図１】第１または第２発明に関する第１実施例を示すためのステッピングモータ用ロータの断面図である。

【図２】図１の下端面図である。

【図３】同じく第２実施例を示すステッピングモータ用ロータの断面図である。

【図４】図３の下端面図である。

【図５】第３または第４発明に関する一実施例を示す断面図である。

【図６】第５発明または第６発明に関する一実施例を示す断面図である。

【図７】図６に用いられるスペーサの一実施例を示す一部破断斜視図である。

【図８】図６に用いられるスペーサの他の実施例を示す斜視図である。

【図９】第７発明の一実施例を示す断面図である。

【図１０】従来のステッピングモータ用ロータの断面図である。

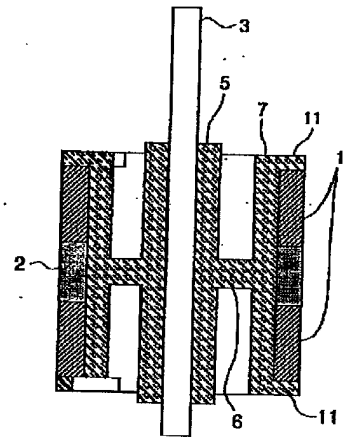
【図１１】図１０の端面図である。

【図１２】図１０のロータの製造方法を説明する図である。

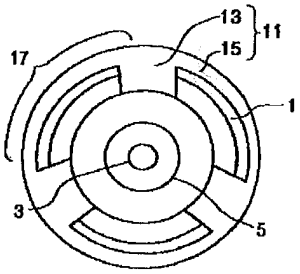
【符号の説明】

１	永久磁石
３	軸
５	ボス部
７	樹脂
９	成形金型
１１	鍔
１３	放射状部分
１５	リング状部分
１７	凹部
１９	支持材
２１	孔部
２３	バネ
２７	スペーサ
２９	保護フランジ部
３１	挿入部
３３	係合部

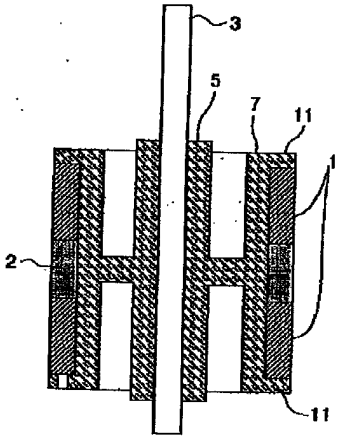
【図１】



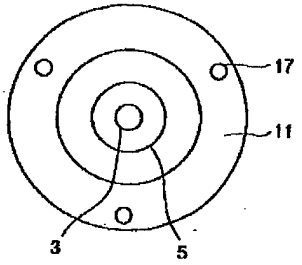
【図２】



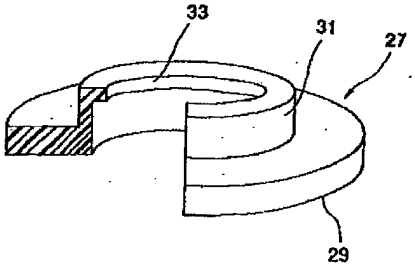
【図３】



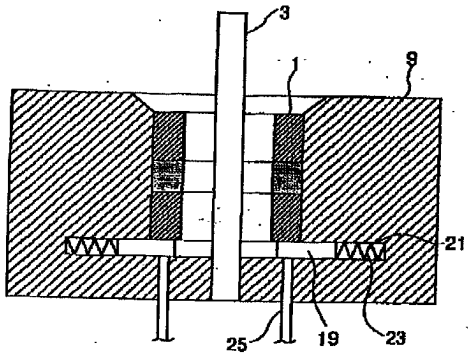
【図４】



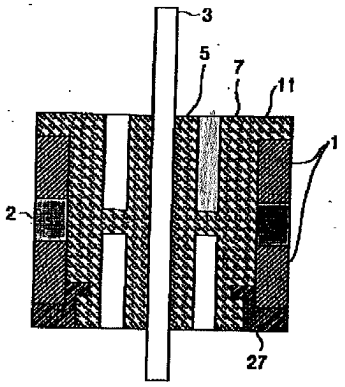
【図７】



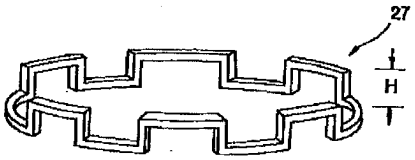
【図5】



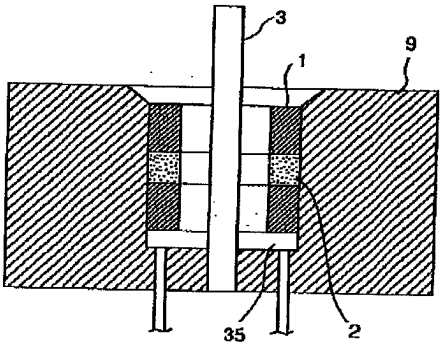
【図6】



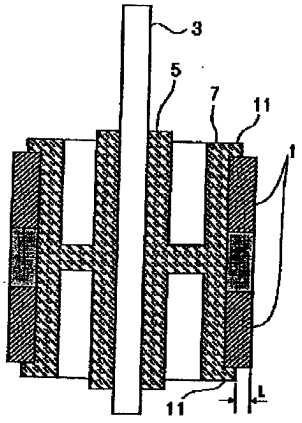
【図8】



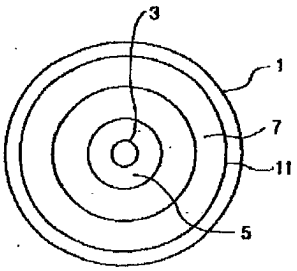
【図9】



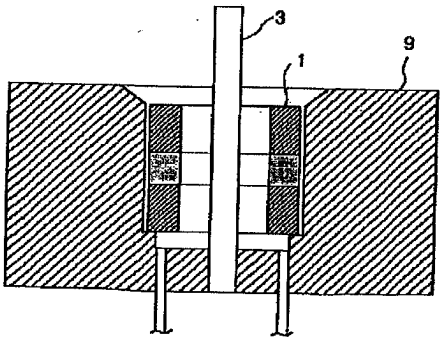
【図10】



【図11】



【図12】



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* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the manufacture method of resin Rota used for example, for a permanent magnet form stepping motor, and its Rota.
[0002]
[Description of the Prior Art] For example, a permanent magnet form stepping motor arranges the stator yoke which has a magnetic pole gear tooth so that resin Rota supported free [rotation] may be countered. This resin Rota consists of a permanent magnet 1 formed in the shape of [in the air] a cylinder, a shaft 3 located at the center of a permanent magnet 1, and a mould resin 7 which carries out fixing fabrication of the inner circumference of the boss section 5 and the aforementioned permanent magnet 1 which this shaft 3 inserts at one, as shown in drawing 10 and drawing 11 .
[0003] such manufacture of resin Rota is shown in drawing 12 -- as -- fabrication -- the shaft 3 which formed pillar-like space in the interior of metal mold 9, and has been arranged by the center of the cylinder-like permanent magnet 1 and a permanent magnet 1 in it lengthwise -- allotting -- a resin -- for example, it was what is performed by carrying out injection restoration and carrying out connection fixation of both 1 and 3
[0004] Thus, the portion of the size L like the thick half had exposed the end face of the permanent magnet 1 of manufactured resin Rota (drawing 10). Namely, as for the end face of a permanent magnet 1, the radial inside was covered for the half with the collar 11 of the resin with which only the size about [of a permanent magnet / thick] a half was installed by radial. thus, a half is exposed and a half is covered with a resin -- a permanent magnet 1 -- fabrication -- the time of allotting perpendicularly into metal mold 9 -- a positioning sake -- the soffit of a permanent magnet 1 -- fabrication -- it is because it is necessary to make the pars basilaris ossis occipitalis of metal mold 9 contact
[0005]
[Problem(s) to be Solved by the Invention] Thus, when the periphery marginal part of the end face of the exposed permanent magnet 1 contacted the stator yoke etc. on the occasion of stepping motor assembly, a chip and a crack occurred, and resin Rota was dropped accidentally and the aforementioned marginal part was damaged completely, it was. If such a chip, a crack, or breakage occurs, the resin Rota will become a defective.
[0006] this invention was accomplished in order to solve the above trouble, it lacks in the periphery marginal part of an end face, and aims at offering Rota for stepping motors which can prevent that a crack or breakage arises, and its manufacture method.
[0007]
[Means for Solving the Problem] Rota for stepping motors which carried out connection fixation of the shaft with which the 1st invention of this application has been arranged at the center of a cylinder-like permanent magnet and this permanent magnet with the resin in order to attain the above purpose -- setting -- the aforementioned resin -- up to the periphery marginal part of the ends side of the permanent magnet of the aforementioned cylindrical shape -- a collar -- it is Rota for stepping motors characterized by being installed by the **
[0008] In the manufacture method of Rota for stepping motors which is filled up with a resin inside and carries out connection fixation of both the 2nd invention -- fabrication -- metal mold -- inside -- a

cylinder-like permanent magnet -- arranging -- the center of this permanent magnet -- a shaft -- length -- arranging -- the aforementioned fabrication -- metal mold -- the aforementioned fabrication -- forming a salient in the pars basilaris ossis occipitalis of metal mold, and making the soffit side of the permanent magnet of the shape of an aforementioned cylinder support -- the aforementioned resin -- up to the periphery marginal part of not only the upper-limit side of the aforementioned permanent magnet but a soffit side -- turning -- being crowded -- a collar -- it is the manufacture method of Rota for stepping motors characterized by being installed by the **

[0009] In the manufacture method of Rota for stepping motors which is filled up with a resin inside and carries out connection fixation of both the 3rd invention -- fabrication -- metal mold -- inside -- a cylinder-like permanent magnet -- arranging -- the center of this permanent magnet -- a shaft -- length -- arranging -- the aforementioned fabrication -- metal mold -- the aforementioned fabrication -- the supporting material which supports the soffit side of the permanent magnet of the shape of an aforementioned cylinder at the pars basilaris ossis occipitalis of metal mold -- preparing -- this supporting material -- the aforementioned fabrication, while being prepared possible [frequent appearance] from the pore formed in the inside of metal mold When it fills up with the aforementioned resin and fabrication is made, it is the manufacture method of Rota for stepping motors characterized by making it absorbed in the aforementioned pore.

[0010] while the supporting material in which this frequent appearance is possible is prepared through a spring and engrossing it in a pore like the 4th invention by the pressure of the resin with which it fills up -- the aforementioned fabrication -- metal mold -- when the Rota mold goods are taken out from inside, it can be made to return to the original position according to the stability of the aforementioned spring

[0011] the spacer which fixes in one with the aforementioned resin to the end face of the permanent magnet of the shape of an aforementioned cylinder in Rota for stepping motors which carried out connection fixation of the shaft with which the 5th invention has been arranged at the center of a cylinder-like permanent magnet and this permanent magnet with the resin -- preparing -- the aforementioned resin -- the gap of this spacer or a spacer -- passing -- up to the periphery marginal part of the aforementioned end face -- a collar -- it is Rota for stepping motors characterized by to be installed by the **

[0012] In the manufacture method of Rota for stepping motors which is filled up with a resin inside and carries out connection fixation of both the 6th invention -- fabrication -- metal mold -- inside -- a cylinder-like permanent magnet -- arranging -- the center of this permanent magnet -- a shaft -- length -- arranging -- the aforementioned fabrication -- metal mold -- The spacer which supports the soffit side of the permanent magnet of the shape of an aforementioned cylinder at the pars basilaris ossis occipitalis of metal mold is arranged. the aforementioned fabrication -- It is the manufacture method of Rota for stepping motors characterized by making the aforementioned resin and this spacer fix in one in the case of fabrication, and installing the aforementioned resin to the periphery marginal part of the aforementioned soffit side through the gap of the aforementioned spacer or a spacer.

[0013] In the manufacture method of Rota for stepping motors which is filled up with a resin inside and carries out connection fixation of both the 7th invention -- fabrication -- metal mold -- inside -- a cylinder-like permanent magnet -- arranging -- the center of this permanent magnet -- a shaft -- length -- arranging -- the aforementioned fabrication -- metal mold -- It supports according to the planar pressure force with the internal surface of metal mold. the aforementioned fabrication -- the bore of metal mold -- the outer diameter of the aforementioned permanent magnet -- small -- setting up -- this permanent magnet -- this fabrication -- pressing fit in metal mold -- the aforementioned permanent magnet -- the periphery and aforementioned fabrication -- the soffit side of this permanent magnet, and the aforementioned fabrication -- between the partes basilaris ossis occipitalis of metal mold -- a crevice -- preparing -- the aforementioned resin -- from the aforementioned crevice up to the periphery marginal part of the soffit side of the aforementioned permanent magnet -- turning -- being crowded -- a collar -- it is the manufacture method of Rota for stepping motors characterized by being installed by the **

[0014]

[Function] a collar -- possibility of a stator yoke etc. contacting this marginal part and producing a chip, a crack, and also breakage with the resin installed by the ** since it is covered to the periphery marginal part of the ends side of a cylinder-like permanent magnet can be made small

[0015] thus, a resin -- a collar -- for installing in a ** -- fabrication -- a salient can be formed in the pars basilaris ossis occipitalis of metal mold, and it can carry out by rotating a resin by preparing a crevice between the soffit side of a permanent magnet, and a pars basilaris ossis occipitalis
[0016] or fabrication -- the supporting material prepared possible [frequent appearance] from the pore formed in the inside of metal mold -- the soffit side of a permanent magnet -- supporting -- this soffit side and fabrication -- it is carried out also by preparing a crevice between the partes basilaris ossis occipitalis of metal mold the pressure of the resin with which prepares this supporting material through a spring and it fills up -- using -- fabrication -- while making it absorbed in the interior of metal mold -- the aforementioned fabrication -- metal mold -- when the Rota mold goods are taken out from inside, it can be made to return to the original position according to the stability of the aforementioned spring
[0017] moreover, instead of [of the aforementioned supporting material] -- the soffit side of a cylinder-like permanent magnet -- a spacer -- supporting -- the gap of a spacer -- passing -- a resin -- a collar -- installed by the **, in this case, a spacer fixes to the end face of the permanent magnet of manufactured Rota in one, and remains in it
[0018] moreover, a permanent magnet -- fabrication -- without it uses the thing which presses fit to metal mold and supports a permanent magnet according to the planar pressure force of pressing fit then the aforementioned supporting material, or a spacer -- up to the end-face periphery marginal part of a cylinder-like permanent magnet -- a resin -- a collar -- it can install in a **
[0019]
[Example] The example about the 1st and 2nd invention is explained based on drawing 1 - drawing 4 . Rota shown in drawing 1 and drawing 2 installs the cylinder-like two permanent magnets 1 in the longitudinal direction of a shaft 3 side by side. Connection fixation of these permanent magnets 1 and the shaft 3 is carried out with the resin 7. That is, the shaft 3 is in the state where it was inserted in the boss section 5 formed with the resin, and the rib 6 which follows the boss section 5 is following the resin 7 of permanent magnet 1 inner circumference in one.
[0020] This resin 7 forms the collar 11 which reaches to the periphery marginal part of the ends side of the cylinder-like permanent magnet 1. That is, in the soffit side, as shown in drawing 2 , the radial portion 13 is formed in the circumferencial direction of Rota in 120-degree pitch. The nose of cam of each radial portion 13 is attained to the periphery marginal part. And a nose of cam is extended to a circumferencial direction, and forms the narrow ring-like portion 15. The radial sizes of this ring-like portion 15 are about about 1 of the thick size of the cylinder of a permanent magnet 1 / 2. Between radial partial 13 comrades, it is the crevice 17 of an abbreviation flabellate, and it is not covered by the resin 7.
[0021] In addition, if it is in this example, although there is no portion which the above crevices 17 are not formed in the collar 11 by the side of the upper-limit side of a permanent magnet 1, but a permanent magnet 1 exposes, you may form the crevice 17 same also to the collar 11 by the side of the upper-limit side of a permanent magnet 1 as a soffit side side.
[0022] Rota shown in drawing 1 and drawing 2 -- fabrication -- it is manufactured by forming the salient (not shown) of an abbreviation flabellate in the pars basilaris ossis occipitalis of metal mold namely, the former -- the same -- fabrication -- the shaft 3 located in the space of the shape of a pillar of metal mold at the permanent magnet 1 of the shape of an aforementioned cylinder and the cylinder-like center is arranged perpendicularly A spacer 2 is formed between two permanent magnet 1 comrades, and a permanent magnet 1, a spacer 2, and a permanent magnet 1 will be in the state where it was put upon the longitudinal direction of a shaft 3 in order, and will be arranged. this fabrication -- the salient of three abbreviation flabellates is formed in the pars basilaris ossis occipitalis of metal mold at intervals of 120 degrees of each To about about 1 of the soffit side thickness of a permanent magnet 1 / 2, the edge of the radial outside of a salient of an abbreviation flabellate contacts, and is supported. Positioning of a permanent magnet 1 is performed by this contact.
[0023] If injection restoration of the resin is carried out after arranging a permanent magnet 1 and a shaft 3, a resin will reach to the periphery marginal part of the wraparound permanent magnet 1 through the gap of salients. Thereby, the radial portion 13 and the ring-like portion 15 of a collar 11 are formed.

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A ROTOR FOR STEPPING MOTORS AND MANUFACTURING METHOD THEREOF

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A ROTOR FOR STEPPING MOTORS AND MANUFACTURING METHOD THEREOF

[Stepping motor yo rotor oyobi sono seizo hoho]

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Claims

1. A rotor for stepping motors, in which a permanent magnet in a cylindrical shape and a shaft, which is positioned at the center of said permanent magnet, are connected and anchored together by resin, characterized by the aforementioned resin being extensionally provided in the shape of a flange all the way to the outer circumferential edge area at both end faces of the aforementioned permanent magnet in a cylindrical shape.

2. A manufacturing method of a rotor for stepping motors, in which a permanent magnet in a cylindrical shape is positioned within a molding die, a shaft is vertically positioned at the center of said permanent magnet, resin is poured into the aforementioned molding die and both the magnet and shaft are connected and anchored together, characterized by projections being formed at the bottom part of the aforementioned molding die and the lower edge face of the aforementioned permanent magnet in a cylindrical shape being supported so that the aforementioned resin enters not only the upper edge face of the aforementioned permanent magnet but also the outer circumferential edge area at the lower edge face and is extensionally provided in the shape of a flange.

3. A manufacturing method of a rotor for stepping motors, in which a permanent magnet in a cylindrical shape is positioned within a molding die, a shaft is vertically positioned at the center of said permanent magnet, resin is poured into the aforementioned molding die and both the magnet and shaft are connected and anchored together, characterized by a supporting member which supports the lower edge face of the aforementioned permanent magnet in a cylindrical shape being provided at the bottom part of the aforementioned molding die, said supporting member being provided in a manner so that it can come in and out of a hole area, which is formed at the inner face of the aforementioned molding die, and it goes into the aforementioned hole area when the aforementioned resin is poured and molded.

4. The manufacturing method of a rotor for stepping motors described in Claim 3 characterized by the aforementioned supporting member, which can come in and out, being provided with an inclusion of a spring, which energizes the supporting member in the aforementioned molding die, it goes into the aforementioned hole area by the pressure of the resin, which is poured into said molding die, and it returns to the original position by the restoring force of the aforementioned spring when a molded rotor is taken out of the aforementioned molding die.

5. A rotor for stepping motors, in which a permanent magnet in a cylindrical shape and a shaft, which is positioned at the center of said permanent magnet, are connected and anchored together by resin, characterized by a spacer, which is integrally anchored to the aforementioned resin, being provided at the edge face of the aforementioned permanent magnet in a cylindrical shape, and the aforementioned resin passing through said spacer or gaps in the spacer and being extensionally provided in a flange shape all the way to the outer circumferential edge area of the aforementioned edge face.

6. A manufacturing method of a rotor for stepping motors, in which a permanent magnet in a cylindrical shape is positioned within a molding die, a shaft is vertically positioned at the center of said permanent magnet, resin is poured into the aforementioned molding die and both the magnet and shaft are connected and anchored together, characterized by a spacer which

supports the lower edge face of the aforementioned permanent magnet in a cylindrical shape being arranged at the bottom part of the aforementioned molding die, the aforementioned resin and said spacer being integrally anchored together at the time of molding, and the aforementioned resin being extensionally provided all the way to the outer circumferential edge area of the aforementioned lower edge face through the aforementioned spacer or gaps of the spacer.

7. A manufacturing method of a rotor for stepping motors, in which a permanent magnet in a cylindrical shape is positioned within a molding die, a shaft is vertically positioned at the center of said permanent magnet, resin is poured into the aforementioned molding die and both the magnet and shaft are connected and anchored together, characterized by the inner diameter of the aforementioned molding die being established to be smaller than the outer diameter of the aforementioned permanent magnet, said permanent magnet being press-fit into said molding die so that the aforementioned permanent magnet is supported by the face pressure between its outer circumference and the face of the inner wall of the aforementioned molding die, a gap being provided between the lower edge face of said permanent magnet and the bottom part of the aforementioned molding die, and the aforementioned resin entering through the aforementioned gap up all the way to the outer circumferential edge area of the lower edge face of the aforementioned permanent magnet and being extensionally provided in the shape of a flange.

Detailed explanation of the invention

[0001]

Industrial application field

This invention concerns a resin rotor used in permanent magnet type stepping motors, for example, and a manufacturing method thereof.

[0002]

Prior art

In a permanent magnet type stepping motor, for example, a stator yoke having a magnetic pole gear is positioned facing a resin rotor, which is supported in a freely rotatable manner. This resin rotor, as illustrated in Figures 10 and 11, for example, consists of a permanent magnet (1) formed in a hollow cylindrical shape, a shaft (3) positioned at the center of the permanent magnet (1), a boss part (5) into which this shaft (3) is fit, and a molding resin (7) which integrally anchors and is molded to the inner circumference of the aforementioned permanent magnet (1).

[0003]

Such a resin motor is manufactured, as illustrated in Figure 12, by forming a space in the form of a column inside a molding die (9), positioning cylindrically shaped permanent magnets (1) and a shaft (3), which is positioned in a vertical direction at the center of the permanent magnet (1) within said space, injection-pouring resin, for example, and connecting and anchoring both (1) and (3) together.

[0004]

The edge face of the permanent magnet (1) of the resin rotor manufactured in this manner has a part of size L, which is about the half its thickness, exposed (Figure 10). More precisely, the inside half of the edge face of the permanent magnet (1) in the direction of the radius is covered by a flange (11) of the resin, which flange is extensionally provided in the direction of the radius for a length of about half the thickness of the permanent magnet. Half is exposed and half is covered with the resin in this manner because it is necessary to allow the lower edge of the permanent magnet (1) to contact the bottom part of the molding die (9) for positioning when vertically positioning the permanent magnet (1) inside the molding die (9).

[0005]

Problem to be solved by the invention

When the outer circumferential edge area of the edge face of the permanent magnet (1) that is exposed in this manner contacts the stator yoke, for example, during assembly of a motor, it occasionally chips and cracks. When a resin rotor was accidentally dropped, the aforementioned edge part sometimes broke completely. When such chipping, cracking, and breaking occur, that resin rotor becomes a defective product.

[0006]

The objective of this invention, which is made for solving the problem above, is to offer a rotor for stepping motors in which chipping, cracking, and breaking in the outer circumferential edge part of the edge face can be prevented, and a manufacturing method thereof.

[0007]

Means to solve the problem

For attaining the objective above, invention 1 in this application is a rotor for stepping motors, in which a permanent magnet in a cylindrical shape and a shaft, which is positioned at the center of said permanent magnet, are connected and anchored together by resin, is characterized by the aforementioned resin being extensionally provided in the shape of a flange

all the way to the outer circumferential edge area at both end faces of the aforementioned permanent magnet in a cylindrical shape.

[0008]

Invention 2 is a manufacturing method of a rotor for stepping motors, in which a permanent magnet in a cylindrical shape is positioned within a molding die, a shaft is vertically positioned at the center of said permanent magnet, resin is poured into the aforementioned molding die and both the magnet and shaft are connected and anchored together, which is characterized by projections being formed at the bottom part of the aforementioned molding die and the lower edge face of the aforementioned permanent magnet in a cylindrical shape being supported so that the aforementioned resin enters not only the upper edge face of the aforementioned permanent magnet but also the outer circumferential edge area at the lower edge face and is extensionally provided in the shape of a flange.

[0009[

Invention 3 is a manufacturing method of a rotor for stepping motors, in which a permanent magnet in a cylindrical shape is positioned within a molding die, a shaft is vertically positioned at the center of said permanent magnet, resin is poured into the aforementioned molding die and both the magnet and shaft are connected and anchored together, which is characterized by a supporting member which supports the lower edge face of the aforementioned permanent magnet in a cylindrical shape being provided at the bottom part of the aforementioned molding die, said supporting member being provided in a manner so that it can come in and out of a hole area, which is formed at the inner face of the aforementioned molding die, and it goes into the aforementioned hole area when the aforementioned resin is poured and molded.

[0010]

As in invention 4, the supporting member, which can come in and out, is provided with an inclusion of a spring, it goes into the aforementioned hole area by the pressure of the resin, which is poured into said molding die, and it returns to the original position by the restoring force of the aforementioned spring when a molded rotor is taken out of the aforementioned molding die.

[0011]

Invention 5 is a rotor for stepping motors, in which a permanent magnet in a cylindrical shape and a shaft, which is positioned at the center of said permanent magnet, are connected and anchored together by resin, which is characterized by a spacer, which is integrally anchored to

the aforementioned resin, being provided at the edge face of the aforementioned permanent magnet in a cylindrical shape, and the aforementioned resin passing through said spacer or gaps in the spacer and being extensionally provided in a flange shape all the way to the outer circumferential edge area of the aforementioned edge face.

[0012]

Invention 6 is a manufacturing method of a rotor for stepping motors, in which a permanent magnet in a cylindrical shape is positioned within a molding die, a shaft is vertically positioned at the center of said permanent magnet, resin is poured into the aforementioned molding die and both the magnet and shaft are connected and anchored together, characterized by a spacer which supports the lower edge face of the aforementioned permanent magnet in a cylindrical shape being arranged at the bottom part of the aforementioned molding die, the aforementioned resin and said spacer being integrally anchored together at the time of molding, and the aforementioned resin being extensionally provided all the way to the outer circumferential edge area of the aforementioned lower edge face through the aforementioned spacer or gaps of the spacer.

[0013]

Invention 7 is a manufacturing method of a rotor for stepping motors, in which a permanent magnet in a cylindrical shape is positioned within a molding die, a shaft is vertically positioned at the center of said permanent magnet, resin is poured into the aforementioned molding die and both the magnet and shaft are connected and anchored together, which is characterized by the inner diameter of the aforementioned molding die being established to be smaller than the outer diameter of the aforementioned permanent magnet, said permanent magnet being press-fit into said molding die so that the aforementioned permanent magnet is supported by the face pressure between its outer circumference and the face of the inner wall of the aforementioned molding die, a gap being provided between the lower edge face of said permanent magnet and the bottom part of the aforementioned molding die, and the aforementioned resin entering through the aforementioned gap up all the way to the outer circumferential edge area of the lower edge face of the aforementioned permanent magnet and being extensionally provided in the shape of a flange.

[0014]

Operation of the invention

The resin, which is extensionally formed in the shape of a flange covers even the outer circumferential edge area at both end faces of the permanent magnet in a cylindrical shape,

therefore, the possibility for the stator yoke, for example, to contact this edge area and to result in chipping, cracking, and breaking, for example, can be reduced.

[0015]

The resin can be extensionally provided in this manner in the shape of a flange by forming projections at the bottom part of the molding die, and providing a gap between the lower edge face of the permanent magnet and the bottom face, which allows the resin to enter around said projections.

[0016]

Or, it can be attained by supporting the lower edge face of the permanent magnet by a supporting member, which is provided in a manner so that it can come in and out of a hole area formed at the inner face of the molding die, and by providing a gap between this lower edge face and the bottom face of the molding die. This supporting member is provided with an inclusion of a spring, it can go into the molding die through the utilization of the pressure of the resin that is poured in, and it can return to the original position by the restoring force of the aforementioned spring when a molded rotor is taken out of the inside of the aforementioned molding die.

[0017]

Also, instead of the aforementioned supporting member, the lower edge face of the cylindrically shaped permanent magnet can be supported by a spacer, and resin can be extensionally provided in the shape of a flange through gaps of the spacer. In this case, the spacer is integrally anchored at the edge face of the permanent magnet of the rotor that is manufactured and remains.

[0018]

Also, the resin can be extensionally provided in the shape of a flange all the way to the outer circumferential edge area at the edge face of the cylindrically shaped permanent magnet without using the aforementioned supporting member or spacer by press-fitting a permanent magnet into a molding die and supporting the permanent magnet by the face pressure during the press-fitting.

[0019]

Application examples

Application examples with respect to inventions 1 and 2 will be explained based on Figures 1-4. In a rotor indicated in Figures 1 and 2, two cylindrically shaped permanent magnets

(1) are arranged in parallel in the longitudinal direction of a shaft (3). These permanent magnets (1) and the shaft (3) are connected and anchored together by resin (7). More precisely, the shaft (3) is in a condition, in which it is inserted into a boss part (5), which is formed by the resin, and a rib (6), which is connected to boss part (5), is integrally connected to the resin (7) at the inner circumference of the permanent magnet (1).

[0020]

This resin (7) forms flanges (11), which reach all the way to the outer circumferential end area at both edge faces of the cylindrically shaped permanent magnet (1). More precisely, at the lower edge face, as illustrated in Figure 2, a part in a radial shape (13) is formed at a pitch of 120° in the direction of the circumference of the rotor. The tip of each part in a radial shape (13) reaches the outer circumferential edge area. Then, the edge extends in the direction of the circumference and forms a narrow ring shaped part (15). The size of this ring shaped part (15) in the direction of the radius is about ½ the thickness of the cylindrical permanent magnet (1). A recessed part in a near fan shape (17) is formed between radial parts (13) and it is not covered with the resin (7).

[0021]

In this application example, the aforementioned recessed part (17) is not formed at the flange (11) at the upper edge face of the permanent magnet (1) and there is no area of permanent magnet (1) exposure, but a recessed area (17) like that of the lower edge face can also be formed at the flange (11) at the upper edge face of the permanent magnet (1).

[0022]

The rotor illustrated in Figures 1 and 2 is manufactured by forming a projection in the shape of a near fan (not illustrated) at the bottom of the molding die. More precisely, as in the prior art, the aforementioned cylindrically shaped permanent magnets (1) and a shaft (3), which is positioned at the center of the cylinder, are vertically positioned within a space in the shape of a column in the molding die. A spacer (2) is provided between the two permanent magnets (1), and a permanent magnet (1), spacer (2), and permanent magnet (1) in this order are positioned in a state in which they are laminated together in the longitudinal direction of the shaft (3). Three near fan shaped projections are formed at the bottom part of this molding die at an interval of 120° each. The edge part in the direction of the radius of the near fan shaped projection contacts about ½ of the thickness of the lower edge face of the permanent magnet (1) and provides support. This contact positions the permanent magnets (1).

[0023]

When the resin is injection-poured after positioning the permanent magnets (1) and the shaft (3), the resin passes through gaps among the projections and enters around and reaches all the way to the outer circumferential edge area of the permanent magnet (1). Through this, the radial part (13) and the ring shaped part (15) of the flange (11) are formed. It is not necessary to form projections for positioning at the upper edge face of the permanent magnet (1), therefore, the aforementioned recessed part (17) is not formed, and the entire upper face is covered by the flange (11) of the resin (7).

[0024]

As explained above, in the application example in Figures 1 and 2, the recessed part (17) is formed at the lower edge face of the permanent magnet (1) and although an edge face of the permanent magnet (1) remains exposed, the outer circumferential edge area is covered by the resin (7), therefore, areas that easily come into contact with other parts, such as an adjacent stator yoke, for example, during the assembly of a stepping motor, for example, can be protected, and the occurrence of chipping and cracking can be avoided. Even when a rotor is accidentally dropped, the possibility for breaking can also be reduced.

[0025]

In the application example above, the projection, which supports the lower edge face of the permanent magnet (1), is in the shape of a near fan. Accordingly, the recessed part (17) is also in a near fan shape. However, as in another application example indicated in Figures 3 and 4, projections can also be formed in the shape of a small column or in a semi-spherical shape so that the recessed part (17) is made small, and the exposure area of the edge face of the permanent magnet (1) can be made small.

[0026]

The number of projections in the application examples above was 3 (Figures 2 and 4), however, it may be 4 or more in other application examples that are not indicated by figures.

[0027]

Furthermore, the number of permanent magnets (1) was 2, however, it may be 1 or 3 or more in other application examples that are not indicated by figures.

[0028]

Next, an application example with respect to inventions 3 and 4 will be explained based on Figure 5. More precisely, projections were provided at the bottom part of the molding die (9) in the aforementioned application examples, but this application example is equipped with supporting members (19), which can come in and out at the inner circumference at the bottom part of the molding die (9). In this application example, this supporting member (19) is a cylindrically shaped movable pin, which is positioned sideways, and is provided inside a cylindrically shaped hole part (21), which is formed at the side wall near the bottom part of the molding die (9), with inclusion of a spring (23). Four, for example, of this supporting member (19) are provided, and they are provided in the direction of the circumference of the inner circumference at the bottom part of the molding die (9) at equal intervals. A spring (23) with a spring constant that allows it to be sufficiently compressed by the pressure of the resin, which is injection-poured, and which can go into the hole part (21) is selected. Injection pins (25) are provided at positions that do not interfere with the 4 supporting members (19) that are provided.

[0029]

As the resin is injected, the space between the permanent magnets (1) and the shaft (3) is gradually filled with the resin. The resin eventually reaches the bottom part of the molding die (9), and the pouring pressure of the resin also reaches the supporting member (19). The supporting member (19) by this pressure moves against the restoring force of the spring (23), and goes into the hole part (21). The permanent magnets (1) become supported by the resin, which has been poured in, before this time of going in, and a gap is maintained between the lower edge face of the permanent magnet (1) and the molding die (9). The resin that has entered this gap is formed in the shape of a flange at the entire lower edge face of the permanent magnet (1).

[0030]

In the application example in Figure 5, the supporting member (19) goes into the hole part (21) through the utilization of the pressure of the resin, which is injection-poured, however, in another application example that is not indicated by figures, the supporting member (19) can be constructed so that it is moved by an electric or mechanical measure, and it can come in and out of the hole part (21). In this way, the supporting member (19) can go in and out while adjusting the timing of the injection as well as the maintenance of the pressure of the resin to the operational timing of the electric or mechanical measure.

[0031]

Next, an application example with respect to inventions 5 and 6 will be explained based on Figures 6-8. More precisely, in the application examples above (Figures 1-5), projections and supporting members were provided at the bottom part of the molding die (9), but in this application example, a spacer (27) is arranged at the bottom part of the molding die (9), and this spacer (27) is integrally anchored to the rotor after resin injection molding, and it becomes a part of the rotor.

[0032]

This spacer (27), as in Figure 7, for example, consists of a protecting flange part (29) which completely covers and protects the lower edge face of the cylindrically shaped permanent magnet (1), an insertion part (31) in a short cylindrical shape which is inserted at the side of the inner circumference of the permanent magnet (1), and an engagement part (33), which sticks out inward from the edge part of the insertion part (31) and engages with the interior of the resin.

[0033]

This spacer (27) is positioned at the bottom part of the molding die (9), the lower edge face of a permanent magnet (1) is mounted on top of it, and they are positioned together. The spacer (27) and the permanent magnets (1) are connected and anchored together by the resin that is afterwards poured in. In this application example, the engagement part (33) of the spacer (27) has a bite-in engagement with the resin in particular, and this helps integral anchoring between the spacer (27) and the resin (7).

[0034]

The upper edge face of the permanent magnet (1) does not require a contact for positioning like the lower edge face, therefore, it does not have to be provided with a spacer (27).

[0035]

In the application example in Figures 6 and 7, the spacer (27) covers and protects the entire lower edge face of the permanent magnet (1), however, as shown in Figure 8, one can also be used, in which only a specific distance is provided between the lower edge face of the permanent magnet (1) and the bottom part of the molding die (9).

[0036]

More precisely, the spacer (27) in Figure 8 is in the shape of a thin ring, which is in the shape of a zigzag wherein recessions and projections are repeated in the longitudinal direction of

the shaft of the cylindrically shaped permanent magnet (1). A space is assured between the aforementioned permanent magnet (1) and the bottom part of the molding die (9) of height H in the longitudinal direction of the shaft, which space is possessed by the step difference in recessed and projection area. This spacer (27) is also integrally anchored when imbedded into the resin (7). The resin during molding passes through gaps in the zigzag shaped spacer and is extensionally provided in the shape of a flange towards the outside in the direction of the radius. This part, which is extensionally provided in the shape of a flange, reaches to the inner circumferential wall of the molding die (9) and covers all the way to the outer circumferential edge area at the lower edge face of the permanent magnet (1).

[0037]

The shape of said spacer (27) is not limited only to those shown in Figures 7 and 8, and various other shapes can also be considered. In brief, a type that covers the entire lower edge face of the permanent magnet (1) by the spacer (27) may have a material or a shape that assure an integral anchoring with the resin. Also, a type that covers the lower edge face by the part of the resin in a flange shape, which resin passes through the spacer (27) and is extensionally provided, is acceptable if a space of specific height may be assured between the lower edge face of the permanent magnet (1) and the bottom face of the molding die (9) such that the resin sufficiently enters around the lower edge of the permanent magnet (1) and can be extensionally provided.

[0038]

Next, an application example of invention 7 will be explained based on Figure 9. In the application examples above, the lower edge face of the permanent magnet (1) is supported by accessories to the molding die (9), such as projections, supporting members (19), and a spacer (27), for example, or a measure separate from the molding die (9), however, in this application example, the permanent magnet (1) is press-fit into the molding die (9), and the permanent magnet (1) is supported by the face pressure between them during molding without using the aforementioned accessories and separate measures.

[0039]

More precisely, when the outer dimension of the cylindrically shaped permanent magnet (1) is about 18 mm, and the thickness is about 1 mm, for example, the column shaped space of the molding die (9) is formed so that its inner diameter has an overlap of about 10 μm (this fastening value generally is allowed up to about 50 μm) with the outer diameter of the aforementioned permanent magnet (1), and the permanent magnet (1) is press-fit into the

molding die (9) with the outer circumferential face of the permanent magnet (1) then having strong contact with the inner wall of the molding die (9). Through the face pressure between the outer circumferential face of the permanent magnet (1) and the inner circumferential face of the molding die (9), the permanent magnet (1), which is press-fit to a specific depth, is supported. A spacer (2) is inserted between the permanent magnets (1). Through this, a specific space (35) can be provided between the lower edge face of the permanent magnet (1) and the bottom part of the molding die (9), and the resin, which is injection-poured through this gap (35), enters around the lower edge face of the permanent magnet (1) and is extensionally provided.

[0040]

In this application example, permanent magnets (1) can be positioned just by press-fitting the permanent magnets (1) and the spacer (2) into the molding die (9), therefore, the resin can enter around the entire lower edge surface pf the permanent magnet (1) and is extensionally provided in a flange shape and covers without the lower edge face of the permanent magnet (1) being supported by a separate measure.

[0041]

In the application example in the aforementioned invention 7 in this application, 1 or 3 ore more permanent magnets can also be used instead of 2.

[0042]

A hollow part formed for reducing weight (around the boss part (5)) is indicated in the cross-sectional figures of the rotors shown in Figures 1, 3, and 6. These hollow parts are formed by a projecting part provided at a male die, for example, which is attached over the molding die (9) shown in Figure 5 or Figure 9, however, the projecting part is eliminated from the illustration to simplify the figures.

[0043]

Effect of the invention

As explained above, through this invention, resin which connects and anchors a permanent magnet with a shaft is extensionally provided all the way to the outer circumferential edge area at both end faces of the cylindrically shaped permanent magnet, and this reduces the possibility of the outer circumferential edge area coming in contact with the stator yoke, for example, during an assembly of a stepping motor, and chipping and cracking, and the possibility of breaking when the rotor is accidentally dropped.

[0044]

The resin is extensionally provided all the way to the outer circumferential edge area in a flange shape as above, therefore, the formation of projections at the bottom part of the molding die offers a practical manufacturing method for manufacturing a rotor for stepping motors that is difficult to chip, crack, or break.

[0045]

By providing supporting members, which can come in and out, at the inner circumferential face of the bottom part of the molding die instead of the aforementioned projections, the part of the permanent magnet that comes into contact with the aforementioned projection can be prevented from exposure without being covered by resin.

[0046]

By particularly providing the aforementioned supporting member with an inclusion of a spring, which energizes the supporting member in the molding die, and designing said member to go into the inner circumferential face of the molding die against the force of the aforementioned spring by the pouring pressure of the resin at the time of injection molding, the supporting member can be moved by just pouring the resin in, the supporting member immediately returns to the original position after taking a molded product out, and the operation can be simplified.

[0047]

Also, by covering all the way to the outer circumferential edge area at the lower edge face of the permanent magnet by the part of the resin in a flange shape, which passes through a spacer as the edge face or gaps in the spacer and is extensionally provided, an exposed part can be prevented from remaining at the edge face of the permanent magnet by a more simplified measure than providing the aforementioned supporting member which can move into a hole.

[0048]

Furthermore, it displays various types of effects, such as not leaving an exposed area that is not covered by resin at the lower edge face of the permanent magnet, for example, without using the aforementioned projections, supporting members, or spacer, for lifting up the bottom face of the permanent magnet from the bottom part of the molding die at a specific distance but by press-fitting the permanent magnet into the molding die, for example.

Brief description of the figures

Figure 1 is a cross-sectional diagram of a rotor for stepping motors for indication of the first application example with respect to invention 1 or 2.

Figure 2 is a diagram of the lower edge face of Figure 1.

Figure 3 similarly is a cross-sectional diagram of a rotor for stepping motors for indication of the second application example.

Figure 4 is a diagram of the lower edge face of Figure 3.

Figure 5 is a cross-sectional diagram showing an application example with respect to invention 3 or 4.

Figure 6 is a cross-sectional diagram showing an application example with respect to invention 5 or 6.

Figure 7 is a partially cut off diagonally viewed diagram showing an application example of the spacer used in Figure 6.

Figure 8 is a diagonally viewed diagram showing another application example of the spacer used in Figure 6.

Figure 9 is a cross-sectional diagram showing an application example of invention 7.

Figure 10 is a cross-sectional diagram of a conventional rotor for stepping motors.

Figure 11 is a cross-sectional diagram of Figure 10.

Figure 12 is a diagram, which explains the manufacturing method of the rotor in Figure 10.

Explanation of symbols

1	Permanent magnet
3	Shaft
5	Boss part
7	Resin
9	Molding resin
11	Flange
13	Part in a radial shape
15	Ring shaped part
17	Recessed part
19	Supporting member
21	Hole part
23	Spring
27	Spacer
29	Protecting flange part

31 Insertion part

33 Engagement part

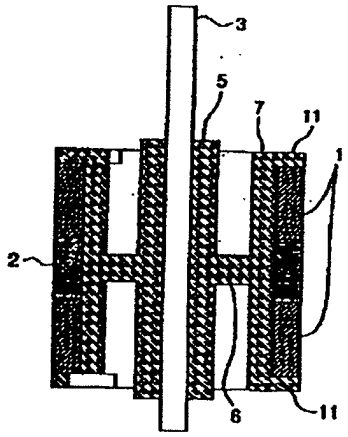

Figure 1

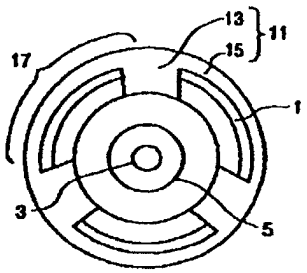

Figure 2

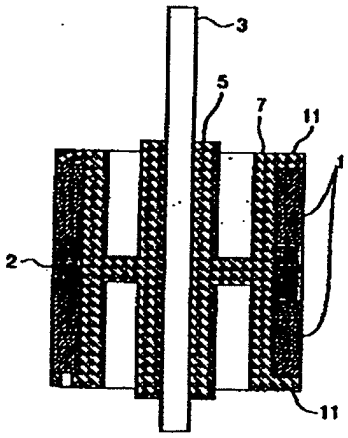

Figure 3

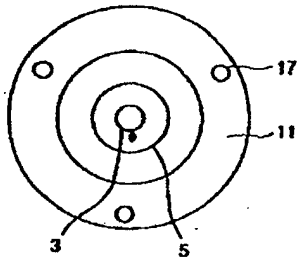

Figure 4

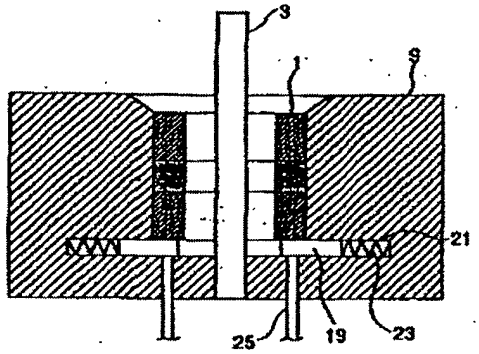

Figure 5

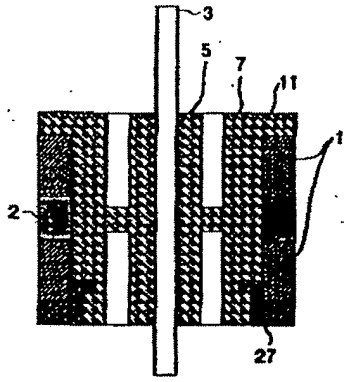

Figure 6

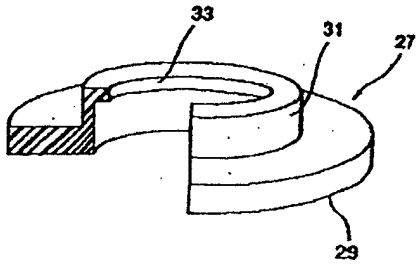

Figure 7

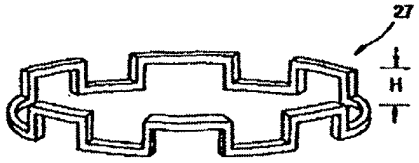

Figure 8

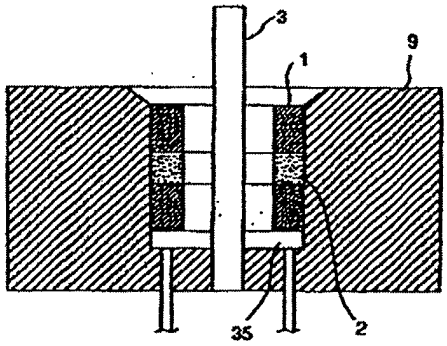

Figure 9

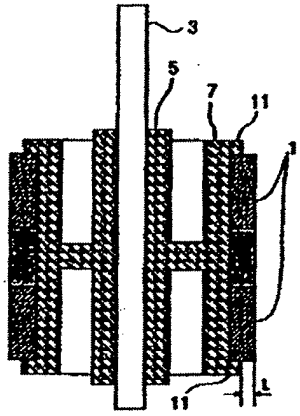

Figure 10

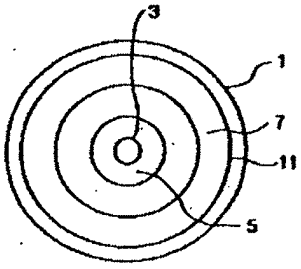

Figure 11

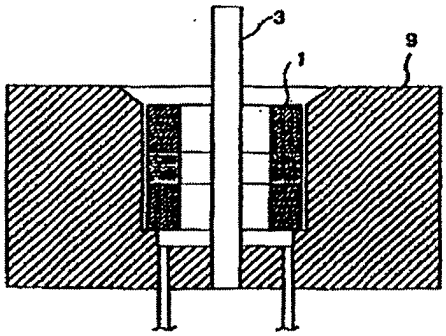

Figure 12